BMS Devens Wastewater Pretreatment Plant System Description

1. Background

Bristol-Myers Squibb (BMS) is proposing to construct a new Large Scale Cell Culture (LSCC) Facility in Devens, MA. The LSCC will be constructed on a previously developed parcel formerly occupied by the Ft. Devens Military base. Major elements of the LSCC facility will include:

- Administrative Office/Laboratory/Cafeteria Building
- LSCC Building
- Central Utilities Building (CUB)
- Materials Storage & Warehouse Buildings
- **Wastewater Pretreatment Plant (WWpTP)**

The facility has been master planned to support phased expansion of the site through the construction of additional production and related support facilities.

2. Wastewater Flows

Process and Utility wastewaters will be conveyed to the wastewater pretreatment plant (WWpTP) to treat the wastestreams prior to discharge to the Devens POTW. The WWpTP will have maximum designed operating flow capacity of 530,000 gallons per day which comprises a redundant system with a capacity of 265,000 gallon for each component. The design will meet the Mass Development (Mass Dev) Finance Agency Sewer Use Rules & Regulations which govern industrial discharges to the Devens Sewerage Service Area.

Sanitary wastewaters generated at the administrative offices, laboratory, manufacturing and cafeteria building will be collected at the site and discharged directly to the Devens Publicly Owned Treatment Works (POTW).

3. Wastewater Flows Characteristics

Wastewater generated from production unit operation (i.e. Process wastewater) will consist of:

- Cell production (bioreactors)
- Spent buffer solutions from purification
- Waste clean-in-place (CIP) solutions
- Used water-for-injection (WFI) from line and equipment flushing

Utility wastewater from the CUB will consist of:

- Boiler blowdown
- Cooling tower blowdown
- Miscellaneous wastewaters

4. Process Description by Unit Operations

The following is a functional description of each of the major process unit operations identified in the Process Flow Diagram (148-980-PFD-001) of the WWpTP:

- Equalization (EQ) Wastewater Cooling
- Equalization
- Aerobic Sequence Batch Reactors (SBR's)
- Aeration blowers
- Post SBR equalization
- Sludge Holding
- Centrifuge
- Odor Control
- Chemical Distribution

4.1. EQ Wastewater Cooling

Two EQ water-cooling towers will be located within the containment berm adjacent to the EQ tanks. The cooling towers are sized to reduce the EQ tank water temperature to below a specified temperature within the EQ tank prior to entering the SBR for treatment. The cooling towers are equipped with a high volume forced draft fan, recirculation pump and distribution internals, sump heater for winter conditions, and corresponding instrumentation and controls for temperature, level and flow control and conductivity.

The EQ tank contents will be recirculated from the tank, through the cooling tower unit operations and discharge back to the EQ tank. Cooling tower influent and effluent piping is configured for operational flexibility providing the ability to recirculate either EQ No. 1 or EQ No. 2 contents to either EQ tank. The cooling tower blowdown rate will be established based on conductivity.

4.2. Equalization (EQ) Tanks

There are two 200,000-gallons wastewater equalization (EQ) tanks - one online and one standby. The EQ tanks receive flow from both the process area and CUB and can automatically transfer operations from EQ No. 1 to EQ No. 2, if required. The tanks are mechanically agitated to provide for composition and hydraulic equalization, and pH adjustment of the wastewaters. Each EQ tank is equipped with redundant level monitoring (radar and high-high level sensor) and redundant pH monitoring. Wastewater pH is adjusted by control of caustic or hydrochloric acid metering pumps. Additional overflow protection is provided with a common pipeline through the EQ tank common wall (just above maximum water level). This pipe, equipped with a manual butterfly valve, would allow high water levels to spill into the adjacent EQ tank.

Provisions are made for temperature monitoring of the wastewater in the EQ tanks. Control of wastewater temperature in the EQ tanks will be via an external cooling tower recirculation loop to maintain the EQ contents at a constant temperature prior to entering the SBRs.

The basis for the EQ tanks sizing is to dampen COD mass load fluctuations to the SBRs. Overfill protection is provided and bypass capability is included for sending flow around the EQ tanks directly to the SBRs. Two EQ tank pumps are provided, and each sized for flows from 250 gpm to 400 gpm each. The EQ tanks are covered and the headspaces are vented to the Odor Control Scrubber.

4.3. Sequencing Batch Reactors (SBRs)

Wastewater from the EQ tanks is pumped alternating into one of two nominal 265,000-gallon SBRs for biological treatment. The SBR cycle includes five main steps: fill/aeration, reacts, settle (clarification), decant, and sludge wasting. Combination steps such as mix-fill or react-fill may also be included.

The SBR feed pumps are common for both SBRs. The SBRs are designed to operate at minimum solids retention time (SRT) of 10 days and are sized to operate with mixed liquor suspended solids (MLSS) concentration of 4,500 mg TSS/L or lower at the minimum water depth (post decanting).

4.4. Post-SBR EQ Tank

The treated effluent from the SBRs is gravity drained to a 120,000-gallon capacity post-SBR EQ tank. Gravity draining, at a rate of 1,000 gpm, allows transfer of up to 60,000 gallons of treated effluent over one hour. The rectangular concrete tank is covered and vented to the Odor Control Scrubber. As per the New England Interstate Water Pollution Control Commission (NEIWPCC), the post-SBR EQ tank is considered to be a key component of the biological system and is sized to meet future requirements. The post SBR EQ tank includes level monitoring and alarm, and redundant pH monitoring. If sustained off spec pH is observed, then the post-SBR EQ tank contents will be diverted to the operating SBR.

Effluent flow is controlled via an automated valve on the post-SBR EQ tank's discharge. This allows the effluent to be a monitored discharge to the Devens POTW for treatment. An on-site control manhole will be used for flow and temperature monitoring, and redundant pH monitoring with deviation alarms. Above the control manhole will be a compliance monitoring station that will house a refrigerated composite sampler and local alarms.

A blower is provided to supply air for mixing in the post-SBR EQ tank. Mixing requirement is based on 25 scfm/1000 cf of tank volume in accordance with the NEIWPCC design guidance manual. The post-SBR headspace is vented to the Odor Control Scrubber.

Provisions are included for bypassing the post-SBR EQ tank to allow for maintenance of the tank. Flexibility will be included to convey to the EQ tanks for additional treatment.

4.5. Sludge Holding Tank (SHT)

A covered 60,000-gallon nominal capacity SHT will receive wastewater sludge from the SBRs. The tank will be used to store the biosolids and feed the Centrifuge. Sizing is based on a 5 days/week dewatering operation. A blower is provided to supply air for mixing in the sludge tank. Mixing requirement is based on 25 scfm/1000 cf of tank volume in accordance with the NEIWPCC design guidance manual. wastewater sludge will be delivered to the tank over a short duration at the end of each SBR cycle. The SHT is equipped with redundant level monitoring. Provisions are included for polymer addition for promoting improved settling characteristics. Post-settling provisions are included for decanting wastewater from above the sludge blanket and recycling the wastewater back to the SBRs. The SHT headspace is vented to the Odor Control Scrubber.

4.6. Centrifuge

Wastewater sludge will be pumped from the SHT using redundant positive displacement rotary lobe pumps, and following conditioning of the sludge with a polymer solution, dewatering of the waste sludge is performed using a solid bowl Centrifuge. The Centrifuge capacity is designed to accommodate the Design Average waste sludge generation rate at a runtime of < 4hr/day on a 5days/wk operation basis. The dewatered sludge cake will be gravity discharged from the Centrifuge into a roll-off container for off-site disposal.

The centrate will be discharged via gravity into a 500-gallon Centrate tank for recycle back to the SBRs with an alternate routing to the post-SBR EQ tank. The Centrate tank will be equipped with redundant level monitoring and discharge pumps. Tank ventilation will be connected to the Odor Control Scrubber.

The Centrifuge will be located within the Control Building on a mezzanine (upper) level above the roll-off container. A floor drain will be provided to direct washdowns in the Centrifuge area to the Centrate tank on the floor below.

Floor washings from the first floor Centrate tank and sludge rolloff area will be collected in a local sump and pumped via redundant pneumatic pumps to the Centrate tank, for conveyance to the EQ tanks or SBRs.

The roll-off container headspace and centrate discharge assembly headspace will be vented to the Odor Control Scrubber.

4.7. Odor Control

Vent off-gas is routed from various areas of the WWpTP to a two-stage outdoor Odor Control Scrubber prior to discharge to atmosphere via a free standing discharge stack. The two stage induced draft packed columns are equipped with redundant recirculation pumps and a pair of induced draft fans. These fans are located to at the downstream of the 2nd stage column and upstream of the discharge stack. The odor control scrubber ductwork is configured to operate either column as a single stage if required for major maintenance.

During normal operation the 1st stage column oxidation reduction potential (ORP) and pH will be controlled by dosing hypochlorite and caustic. The 2nd stage column will adjust the final pH using caustic.

Each column is equipped with level monitoring, redundant pH, ORP, and conductivity monitoring that is located in each column sump. Caustic and hypochlorite chemical dosing is injected into each respective recirculation pump discharge header. Scrubber recirculation flow rate is continuously monitored. Sump liquid level is maintained by operation of an on/off solenoid controlled via high/low level switches. Each column is equipped with a sump heater and thermostat monitoring for anti-freezing protection.

Scrubbed fume flow discharges via a free standing discharge stack equipped with mist-eliminator. A portion of the recirculated scrubber liquor is conveyed to the WWpTP tanks to control the TDS.

4.8. Chemical Distribution

Bulk unloading and chemical storage systems are designed to be in substantial compliance with the New York State Chemical Bulk Storage Regulations. Bulk unloading of chemicals and tote delivery will be performed inside the building. The chemicals used at the WWpTP include the following:

- 37% ferric chloride

- 25% caustic
- 15% sodium hypochlorite
- 32% hydrochloric acid
- anti-foam
- neat and dilute polymer
- urea
- cooling tower chemicals
- diesel fuel

Ferric chloride, caustic, hydrochloric acid, and sodium hypochlorite are stored in 5,000-gallon storage tanks inside the Control Building. Each tank is equipped with level monitoring and redundant high level alarm (via level switch) to provide notification at 90% and 95% of tank level for operator intervention. Each respective chemical is stored within its own containment with sump and spill monitoring. Each are provided with dedicated metering pumps for respective usage points. The chemical metering pumps are cross connected to provide redundancy.

Urea, anti-foam, and polymer will be delivered in tote quantities. Each permanent tote is equipped with level monitoring and alarming functionality. Chemical distribution from each tote will be conveyed via dedicated metering pumps to each respective usage point, and will be cross connected for redundancy.

The neat polymer and antifoam each are provided with a 1000-gallon and 600-gallon make-down tank, respectively. Each make-down tank will be equipped with tank mixers and level monitoring. Polymer and anti-foam make down will be performed using a drum pump. Polymer, urea and anti-foam will be located within the Chemical/Process Room inside the Control Building.

Space within the Control Building has been allocated (if required) for miscellaneous cooling tower chemicals. 55-gallon translucent drums with dedicated metering pumps will be manually operated.

The Standby Generator will house a double contained diesel fuel tank. Fuel for the outdoor generator will be unloaded within the Control Building. The diesel storage tank will be equipped with level monitoring and alarm functionality at the unloading area for operator notification and intervention at high and high-high alarms.